The U.S. Army Combat Capabilities Development Command (DEVCOM) leads in the discovery, development and delivery of technology-based capabilities to enable Soldiers to win our nation's wars and come home safely. DEVCOM is a major subordinate command of the U.S. Army Futures Command. The DEVCOM Chemical Biological Center is the Army's principal research and development center for chemical and biological defense technology, engineering and field operations. The DEVCOM Chemical Biological Center is headquartered at Aberdeen Proving Ground, Maryland.

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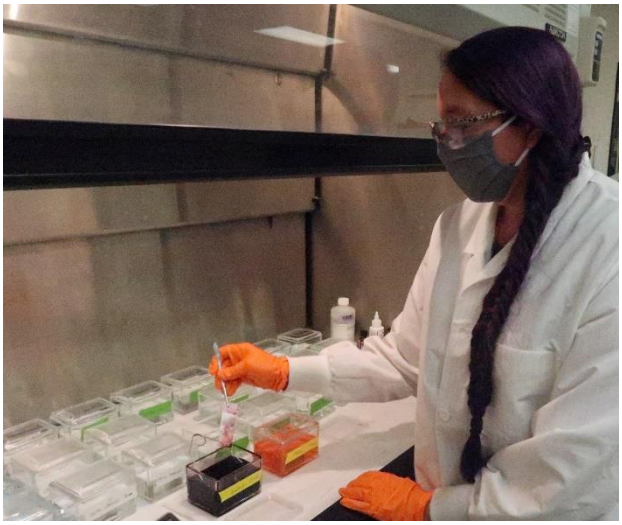
Army Researchers Apply AI/ML in Pursuit of Solutions for Soldiers

By Dr. Brian B. Feeney



Julie Renner, a Center biologist, manually stains agent-exposed liver tissue sections. Her AI/ML seed project aims to replace this laborious technique with digital staining using a computer.

Aberdeen Proving Ground, MD – The U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) is internally funding five new artificial intelligence/machine learning (AI/ML) seed projects this year. These projects all have the potential to assist the Center and its partners in the development of new technologies for the warfighter.

"The purpose of the small projects is to generate quick wins for getting better technology into the hands of the warfighter. But they also provide an opportunity for our researchers to educate themselves on how to structure and process data using AI/ML techniques," said Patrick Riley, a Center research chemist who is heading up the effort. "Ultimately, we want to establish AI/ML as a routine part of Center researchers' skill set to ensure that the technologies we develop for the warfighter flow from the best research and design possible."

For example, Center researchers have been designing a type of molecule called a metal-organic framework (MOF) for years now. They use a system of molecular struts and nodes to trap and then neutralize chemical agents as they enter its internal spaces. "We are continually working to develop metal-organic frameworks with improved ability for decontaminating toxic chemicals by modifying their physical and chemical properties," said Matt Browe, a Center chemical engineer who is on a team that received one of the five seed project awards, which averaged $16,000 this year. "Machine learning holds the potential for identifying correlations between different physical and chemical properties of MOFs and how well they perform particular reactions. This helps in designing better experiments for future efforts and largely avoids the trial-and-error approach to developing better materials that is often used in purely experimental efforts."

Another awardee, Julie Renner, a Center biologist, is using AI/ML to contribute to an important ongoing research effort in her field. “Current practice for identifying pathologies in tissue samples is to use liquid stains to make any pathologies in the cells and tissues stand out when viewed under a microscope,” said Renner. “It’s a slow, meticulous process and the stain is a hazardous material that produces wastes, so it is expensive to purchase and dispose of.” She is using AI/ML to train an algorithm to stain tissue slides virtually instead of by using chemicals.

“Digital staining solves this problem and also saves on time and labor,” said Renner. “It stains in seconds and eliminates the staining inconsistencies that inevitably come with staining by hand. In essence, I have the algorithm play a game with itself to keep improving its staining quality so that it can no longer distinguish between a sample it stained itself and a sample that was chemically stained by me.”

Her goal is to use the algorithm to provide answers to research questions more quickly by streamlining the staining step. That, in turn, speeds up the process of discovering how different chemical agents damage cells and aids researchers in quickly gaining an understanding of the effects of new emerging agents on humans.

AI/ML can also help Center researchers get the materials they need to do their work. The pandemic has brought the nation’s vulnerability to supply chain disruptions into sharp focus. This is of great concern in the case of vital defense materials. The Center’s Industrial Base Information Technology Team has the job of making sure that the armed services are able to get what they need to defend the nation – quickly and conforming to specifications.

A member of this team, Steve Beck, a Center engineer, is using his seed money to train an algorithm to pose queries against a database of Army procurement and Dun and Bradstreet financial risk ratings to identify the key characteristics about individual Army suppliers that most closely correlate with supplier risk.

The goal of this project is to apply AI/ML to add another layer of depth to the team’s analysis of supplier risk. “We plan to use the results to create information summaries for individual suppliers and even create visualizations to quickly identify risks,” said Beck. “Ideally, using AI/ML techniques will allow us to predict risk for the Army supplier base and alert purchasing agents of the need to take mitigating actions before any issues occur.”

This effort is in keeping with goals set forth by DEVCOM and its higher headquarters, the Army Futures Command (AFC). AFC’s goal is to use AI/ML to not only modernize the weapons and protective systems they develop, but to also modernize the workforce. In August 2020, the Army’s Artificial Intelligence Task Force announced that it was making AI/ML education available to all Army Futures Command employees. The ultimate goal is for the entire Army to have a tech-ready and AI/ML-enabled culture.

The AI/ML effort is just one way that DEVCOM Chemical Biological Center is leading by example. “We have a hundred-year-plus history of finding better ways to accomplish the mission here at the Center,” said DEVCOM Chemical Biological Center Director Dr. Eric Moore. “By incentivizing this kind of hands-on experience using AI/ML for everyone from bench chemists to equipment designers to logistics planners, the warfighters get better chemical biological defense technology in their hands and they get it faster.”

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